Development and preclinical testing of new devices for cell transplantation to the brain.

Grant Award Details

Development and preclinical testing of new devices for cell transplantation to the brain.

Grant Type: Tools and Technologies II

Grant Number: RT2-01975

Project Objective: The project objective is to design, develop, optimize and test a novel device for the delivery of cells to large areas of the brain via a single intracranial penetration.

Investigator:

Name: Daniel Lim

Institution: University of California, San Francisco

Type: PI

Disease Focus: Neurological Disorders, Parkinson's Disease

Award Value: $1,795,891

Status: Closed

Progress Reports

Reporting Period: Year 1

View Report

Reporting Period: Year 2

View Report

Reporting Period: Year 3

View Report

Reporting Period: NCE

View Report

Grant Application Details

Application Title: Development and preclinical testing of new devices for cell transplantation to the brain.

Public Abstract:

The surgical tools currently available to transplant cells to the human brain are crude and underdeveloped. In current clinical trials, a syringe and needle device has been used to inject living cells into the brain. Because cells do not spread through the brain tissue after implantation, multiple brain penetrations (more than ten separate needle insertions in some patients) have been required to distribute cells in the diseased brain region. Every separate brain penetration carries a significant risk of bleeding and brain injury. Furthermore, this approach does not result in effective distribution of cells. Thus, our lack of appropriate surgical tools and techniques for clinical cell transplantation represents a significant roadblock to the treatment of brain diseases with stem cell based therapies. A more ideal device would be one that can distribute cells to large brain areas through a single initial brain penetration.

In rodents, cell transplantation has successfully treated a great number of different brain disorders such as Parkinson's disease, epilepsy, traumatic brain injury, multiple sclerosis, and stroke. However, the human brain is about 500 times larger than the mouse brain. While the syringe and needle transplantation technique works well in mice and rats, using this approach may not succeed in the much larger human brain, and this may result in failure of clinical trials for technical reasons.

We believe that the poor design of current surgical tools used for cell delivery is from inadequate interactions between basic stem cell scientists, medical device engineers, and neurosurgeons. Using a multidisciplinary approach, we will first use standard engineering principles to design, fabricate, refine, and validate an innovative cell delivery device that can transplant cells to a large region of the human brain through a single brain penetration. We will then test this new prototype in a large animal brain to ensure that the device is safe and effective. Furthermore, we will create a document containing engineering drawings, manufacturing instructions, surgical details, and preclinical data to ensure that this device is readily available for inclusion in future clinical trials.

By improving the safety and efficacy of cell delivery to the brain, the development of a superior device for cell transplantation may be a crucial step on the road to stem cell therapies for a wide range of brain diseases. In addition, devices and surgical techniques developed here may also be advantageous for use in other diseased organs.

Statement of Benefit to California:

The citizens of California have invested generously into stem cell research for the treatment of human diseases. While significant progress has been made in our ability to produce appropriate cell types in clinically relevant numbers for transplantation to the brain, these efforts to cure disease may fail because of our inability to effectively deliver the cells. Our proposed development of a superior device for cell transplantation may thus be a crucial step on the road to stem cell therapies for a wide range of brain disorders, such as Parkinson's disease, stroke, brain tumors, epilepsy, multiple sclerosis, and traumatic brain injury. Furthermore, devices and surgical techniques developed in our work may also be advantageous for use in other diseased organs. Thus, with successful completion of our proposal, the broad community of stem cell researchers and physician-scientists will gain access to superior surgical tools with which to better leverage our investment into stem cell therapy.